

## **Dissociating the effect of reward and salience on saccadic decisions**

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How do distinct sensory and economic attributes like salience and reward combine to guide where we look? Are saccadic decisions dominated by visual salience or reward? Do saccadic decisions, like purely economic decisions, fail to maximize expected reward? To study this, we designed a treasure hunt experiment in which subjects were presented with a brief display containing two targets (horizontal and vertical bar) differing in reward and salience, embedded among several tilted distractors. Subjects were instructed to maximize the treasure earned in half a second, by fixating on as many stimuli and earning their corresponding reward values. Across 28 blocks, we systematically varied target reward and salience values. We analyzed the first saccade by testing four different hypotheses: 1) the observer searches for the most rewarding item, 2) most salient item, 3) item with highest expected reward, 4) the observer saccades to the location of maximum expected reward. Data from 6 subjects shows that instead of searching for a predefined target, humans optimize reward trial-by-trial, by saccading to the location of maximum expected reward. These findings generalize to multiple feature dimensions like orientation and intensity.

The optimal model predicts, and we empirically validate in humans, that for low internal noise in stimulus representation, intermediate reward values increase the effective stimulus salience multiplicatively, suggesting an underlying neural mechanism of gain control.

Attention is also known to operate through a gain control mechanism, which raises an interesting question: are the effects of reward mediated through attention? According to this hypothesis, the rewarding target's features receive greater attention, hence drawing more saccades. In a second experiment, we find that attention to a stimulus feature makes the stimulus appear more salient, however, rewarding a stimulus does not alter its appearance or perceived salience. Thus, reward and attention interact with salience through distinct mechanisms.